$$V=\tfrac{9}{2}b^9\int_0^{\frac{1}{4}\pi}\theta\tan^5\theta(1-\tan^2\theta)^3\sec^8\theta\,d\theta+\tfrac{9}{2}b^9\int_0^{\frac{1}{2}\pi}\sin^{14}\theta\cos^4\theta\log\frac{1+\cos\theta}{\sin\theta}d\theta$$

$$+\tfrac{9}{2}b^9\int_0^{\frac{1}{2}\pi}\sin^6\theta\cos^5\theta(\cos^2\theta\sin^2\theta-1)\,d\theta$$

$$=\tfrac{2}{35}\pi a^3-\frac{63074663899a^3}{390329139200}+\frac{1287a^3}{131072}\int_0^{\frac{1}{2}\pi}\log\cot\tfrac{1}{2}\theta\,d\theta$$

$$=\tfrac{2}{35}\pi a^3-\frac{63074663899a^3}{390329139200}+\frac{2389\pi^2a^3}{1310720}\text{ nearly.}$$

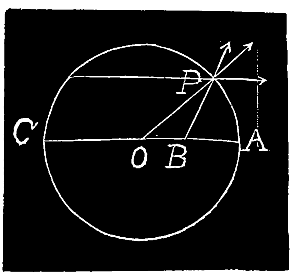
MECHANICS.

203. Proposed by J. EDWARD SANDERS, Reinersville, Ohio.

A train weighing $T(=80)$ tons runs first eastward and then westward in latitude $\lambda(=40^\circ)$ at a velocity $v(=45)$ miles an hour. Find the difference between the pressures on the ground in the two cases.

Solution by G. B. M. ZERR, A. M., Ph. D., 4243 Girard Avenue, Philadelphia, Pa.

In the figure, let P be the point of the train on the λth $(=40\text{th})$ parallel, O the center of the earth, PB the normal at P, $\angle POA=\theta$, $\angle PBA=\lambda$, $OA=a=20923536$ feet, $OP=r$, $CP=2\rho$, $e=$the earth's ellipticity, $e^2=.006920928$, $F=$centrifugal force in direction OP, and $f=$centrifugal force in direction CP. Then $\rho=r\cos\theta=a\cos\lambda/\surd(1-e^2\sin^2\lambda]=16051229$ feet.



$V_P=\dfrac{2\pi\rho}{t}$, where $t=1$ day, $=\dfrac{2\pi\rho'}{86400}=1167.28$ feet per second, the velocity of P due to the earth's rotation.

V_P-V_R, where $V_R=$train's velocity in feet per second, $=1167.28$ feet-66 feet$=1101.28$ feet, train's velocity in space going west.

$V_P+V_R=1167.28$ feet$+66$ feet$=1233.28$ feet, train's velocity in space going east.

$f=TV_1^2/g\rho=TV_1^2/(gr\cos\theta)$, $F=f\cos\lambda=TV_1^2\surd(1-e^2\sin^2\lambda)/ag$, and $g=G(1+\frac{1}{4}e^2\sin^2\lambda)$, where $G=32.2015235$, gravity at the equator.

$\therefore g=32.2245411$ feet per second; $\therefore F=0.000000119V_1^2$ tons.

$F_W=0.1443253$ tons, going west; $F_E=0.15209796$ tons, going east.

Difference$=0.00777266$ tons$=15.545$ pounds. (See Vol. VI, No. 11, page 282, and Vol. IX, No. 2, page 32.)

Also solved by G. W. Greenwood and J. Scheffer. These gentlemen omitted the earth's ellipticity in their solutions and consequently their result differs from that of Dr. Zerr.